
Appendix B

Water Control Plan

7-01. General Objectives. Engineering Regulation 1110-2-1400, dated 24 April 1970, assigns Corps of Engineers reservoir regulation responsibilities in the Missouri River basin to the Missouri River Division Engineer, now the Northwestern Division, Missouri River Basin Water Management Division. This engineering regulation permits delegation of certain reservoir regulation responsibilities to the District Engineer, in whose area the project is located. The responsibilities for assembly and interpretation of data affecting current reservoir regulation and for carrying out routine regulation of Chatfield Reservoir, according to plans agreed on in advance, have been delegated to the Omaha District Engineer. The Division Engineer, through the Missouri River Basin Water Management Division, monitors and reviews the regulation activities performed by the Omaha District. Plate 57 (not included) shows the organizational chart for the Omaha District in regards to Chatfield Reservoir regulation. Exhibit II (not included) contract between the United States of America and the State of Colorado, describes the operation of Chatfield for different pool elevations and reservoir zones.

7-02. Constraints. The recommended limit for rate of release increase is 500 cfs/day during normal conditions. There should be communication with stakeholders if that amount will be exceeded. Unforeseen problems, such as levee breaks, and streambank erosion, could limit discharges during flood control operation.

The control point for Chatfield Dam regulation is 5,000 cfs at the South Platte at Denver gage which includes Cherry Creek and Bear Creek Dam releases as well as incremental runoff. Flood control operation is described in detail in paragraph 7-05. Channel capacity varies widely downstream of the dam. Immediately downstream of the dam, flows of 5,000 cfs will exceed the channel capacity in some areas. Through Denver, channel capacity is much higher with some locations able to contain flows of 24,000 cfs. Downstream from Denver through the rural areas the natural channel flows wide and shallow and the present channel capacity is less than 5,000 cfs in some areas. Protection afforded these areas above and below Denver, therefore, will not be as great as that through Denver. In addition, it would require considerably more storage space to control the reservoir design flood if releases were restricted to less than 5,000 cfs.

7-03. Overall Plan for Water Control. The normal regulation of Chatfield Reservoir involves responsibilities of the State of Colorado and of the Corps of Engineers.

a. State of Colorado Responsibilities - The State of Colorado will be represented by the Colorado State Engineer. The State Engineer is responsible for administration of all State water laws and accounting for ownership of all water stored in the conservation zone (5385.0-5432.0 feet above msl) of the reservoir. The State Engineer is responsible for satisfying all downstream water requirements below the Chatfield Project, including irrigation and/or water supply diversions, flows for the proposed fish hatchery, and normal river flows. The State Engineer will determine what daily river release rates are necessary to meet the downstream water requirements and will issue the necessary regulation release orders directly to the Tri-Lakes Project Office

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for releases to be made from the conservation pool.

The State of Colorado and the Corps of Engineers will regulate the joint-use pool (5432.0 – 5444.0 feet above msl) for water supply and flood control, respectively. When reservoir levels are in the joint-use zone, the Corps of Engineers will only operate for flood control purposes when reservoir pool levels are forecasted to rise above elevation 5444.0. At that time the Corps of Engineers may initiate releases to minimize the maximum reservoir pool elevation.

Tri-Lakes Project Office personnel will make all gate changes to valves physically located before the stilling basin, which include the east and west service and low flow gates in the outlet works. At the discretion and under the supervision of the State Engineer, personnel of the irrigation and/or water supply districts may perform the physical operation of the outlet gate valves at their impact basins to supply water directly from the reservoir to their respective water supply ditches. The Colorado Division will control their releases to the planting base at the valve located at the connection to the 54" irrigation pipe. The State Engineer will monitor and control the amount of water taken by each ditch. The State Engineer will be responsible for maintaining up-to-date, stage-discharge tables for downstream reservoir river release flow. The State Engineer through the canal operating agency will furnish the Tri-Lakes Project Office with the daily canal discharge. Further responsibilities of the State Engineer are presented in the operating agreement between the State Engineer and the District Engineer, Exhibit II (not included).

b. Corps of Engineers Responsibilities - The operation of the Chatfield Reservoir involves two units of the Omaha District, Corps of Engineers as described in paragraphs 7-03-b-1 and 7-03-b-2 below. Additional responsibilities of the Corps are also outlined below.

(1) Water Control and Water Quality Section, Engineering Division.

This section is responsible for matters pertaining to the regulation of the reservoir. Throughout the year this section monitors reservoir releases made from the conservation and joint-use pools by the State Engineer. When the pool level is in or forecasted to enter the exclusive flood control pool, this section is responsible for scheduling reservoir releases so as to attain optimum flood control benefits and control of project storage to assure regulation in conformance with the authorized functions of the project. The normal allowable increase in releases at Chatfield Dam is 500 cfs/day. The section is responsible for procurement of necessary snow pack, precipitation, streamflow, and reservoir elevation data. The section also makes advance estimates of streamflow from snow cover and/or rainfall reports for regulation purposes and to alert field operating personnel of potential flood occurrences. The Water Control and Water Quality Section prepares the monthly reservoir report (MRD Form 0168) for Chatfield Reservoir, which contains daily elevation, inflow and outflow, Plate 58 (not included). The section will issue reservoir regulation orders as outlined in paragraph 7-03-b-4.

(2) Tri-Lakes Project Office, Operations Division. The Operations Division plans and directs the maintenance and physical operation of the project. This Division establishes the standards of maintenance and provides proper staffing of operating personnel at the Tri-Lakes Project Office to accomplish these objectives. The Tri-Lakes Project Office staff performs all gate changes at Chatfield Dam.

(3) Flood Period Organization. The normal organization of the Omaha District is somewhat modified during a flood period to take care of the additional duties made necessary by the flood emergency. The duties are to: 1) operate the flood control reservoirs for maximum protection; 2) collect and disseminate flood information; 3) protect Corps of Engineers' property and works; 4) obtain engineering data; and 5) in extreme emergency, assist in relief and rescue work. These activities take precedence over normal work and are performed by those employees of the District who have been trained for specific emergency duties. The assigned duties of the personnel during these flood periods are contained in Omaha District's Annex A to EM-500-1-1, Standing Operating Procedures for Flood Emergency Operations. In case of purely local flooding in a reservoir controlled basin, such as Chatfield or Cherry Creek, only those units of the District Organization concerned with the normal operation of the reservoir are placed in an emergency status. A directory of regulation personnel is shown in the Standing Instructions to the Dam Tender, Exhibit I (not included).

(4) Regulation Orders. When it is the responsibility of their respective offices as indicated in Paragraph 7-01, the State Engineer and the Omaha District Water Control and Water Quality Section will issue regulation orders directly to the Tri-Lakes Project Office. All requests for regulation of project releases, other than regulation responsibilities of the State Engineer, will be referred to the Water Control and Water Quality Section for approval and issuance of orders. All regulation orders will normally be issued verbally, and then confirmed in writing as soon thereafter as possible. An official reservoir regulation order will be issued in writing by the Water Control and Water Quality Section for all gate changes made at Chatfield Dam, those initiated by the State Engineer and otherwise. Tri-Lakes Project Office personnel will record the gate setting for each gate change in the pool report spreadsheet which can be accessed by the Water Control Manager to complete the written order. A copy of all orders issued by the Water Control and Water Quality Section will be furnished to the State Engineer and the Tri-Lakes Project Office. This copy will contain a brief statement giving the background and reasons for issuance of the order.

(5) Emergency Organization. It is not anticipated that any emergency organization other than provided in paragraph 7-03-b-3, as described above, will be required. However, under the provisions of the Standing Instructions to the Dam Tender, communication failure during a flood event may result and isolate the dam tender, thus making him the sole project operating organization. The Standing Instructions to the Dam Tender provide detailed instructions for regulation of project releases and storage under such emergency conditions.

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(6) Coordination with Other Agencies. Daily project operating data and miscellaneous hydrologic information will be exchanged between the Project Office, the State Engineer and the Water Control and Water Quality Section. Cooperation is also maintained with the U.S. Geological Survey and Colorado Division of Water Resources relative to the collection and reporting of precipitation amounts, stream stages and discharge, the Natural Resources Conservation Service for snow pack and runoff information, and the National Weather Service for precipitation forecasts.

(7) Communication. Telephone facilities are presently available for communication between the Project Office, State Engineer and Water Control and Water Quality Section. In event of loss of these means of communication, the dam tender may communicate via vehicular travel between the respective offices noted above, and/or via cellular phone.

7-04. Standing Instructions to Dam Tender. Exhibit I (not included) contains the detailed Standing Instructions to Dam Tender. The Standing Instructions to the Dam Tender provide detailed instructions for regulation of project releases and storage under emergency conditions, such as communication failure. This failure may result and isolate the dam tender, thus making that person the sole project operating organization.

7-05. Flood Control. Chatfield Dam and Reservoir will be regulated for flood control to prevent damage to the metropolitan area of Denver from floods originating on the South Platte River upstream of the project location.

In general, the developed method of flood control regulation of Chatfield Reservoir may be classified as Method C, defined in EM 1110-2-3600. This represents a combination of the concept of reducing downstream damaging stages as much as possible during each flood with the currently available storage space, with consideration of control of floods of project design magnitude.

The State of Colorado and the Corps of Engineers will regulate the joint-use pool (5432.0 – 5444.0 feet above msl) for water supply and flood control, respectively. When reservoir levels are in the joint-use zone, the Corps of Engineers will only operate for flood control purposes when reservoir pool levels are forecasted to rise above elevation 5444.0. At that time the Corps of Engineers may initiate releases to minimize the maximum reservoir pool elevation. After the flooding period is over, flood storage evacuation of Chatfield Reservoir must be coordinated with Cherry Creek and Bear Creek Reservoirs. Regulation plans are given in the following paragraphs.

a. Rising Pools/Flood Inflow Period. During flood inflow periods and/or rising pool levels Chatfield, Cherry Creek and Bear Creek Reservoirs will be regulated to assure safe control of each flood event. Releases from the dams will be based on forecasted and observed inflows and pool levels as well as downstream flows. During periods of forecasted flood inflows or while the pool level is in the flood control zone,

releases will generally be kept as large as possible up to the 5,000 cfs target at the Denver gage on the South Platte River. The Denver gage includes releases from Chatfield, Cherry Creek, and Bear Creek Dams as well as incremental runoff below the dams. Releases from the three dams from the forecasted flood onset to the complete evacuation of flood storage will be at the discretion of the Water Control and Water Quality Section.

The normal allowable increase in releases at Chatfield Dam is 500 cfs/day. There have been many occasions when the daily change in releases exceeded the normal maximum of 500 cfs/day with largest being 1170 cfs/day in May 1984. The maximum outlet works discharge capacity from Chatfield is 8300 cfs at a pool elevation of 5500 feet above msl. The historic maximum release from Chatfield was 3350 cfs in July 1995.

b. Design Assumptions for Flood Control Storage. Rainfall runoff from major storm events occurs so rapidly in this area that a shortened time window is afforded for thoroughly evaluating downstream flood conditions. In order to provide the best downstream flood control, in the reservoir design of Chatfield and Bear Creek Projects, no releases were planned during flood events. The original design was based on experience in operating Cherry Creek Reservoir. Chatfield Project design storage was based on releasing no water for five days after the heaviest portion of the rainfall, then initiating a release of 500 cfs and increasing releases of 500 cfs a day until a release of 5,000 cfs was achieved. Bear Creek Project design storage was based on releasing no water for two days, then progressively increasing releases as the flood pool was filled, to a maximum of 1,500 cfs. Cherry Creek Reservoir was designed to store all flood inflows, but studies are underway evaluating the adequacy of Cherry Creek Reservoir's storage during large rain events.

With the proposed multi-purpose pool elevation of 5444 ft, the maximum pool elevation during the Reservoir Design Flood (RDF) does not stay below the spillway crest when using the original design criteria of a 5-day shutdown period with a 500 cfs per day stepped-release. Alternative design criteria for reservoir operations included a) a shutdown period adjusted to 2 days while the stepped-release remained 500 cfs per day and b) a shutdown period at 5 days and increased the stepped-release to 1,300 cfs per day. Both alternatives are considered acceptable design assumptions and during the RDF both resulted in a maximum pool elevation below the spillway crest, see Figure 7-1 and 7-2.

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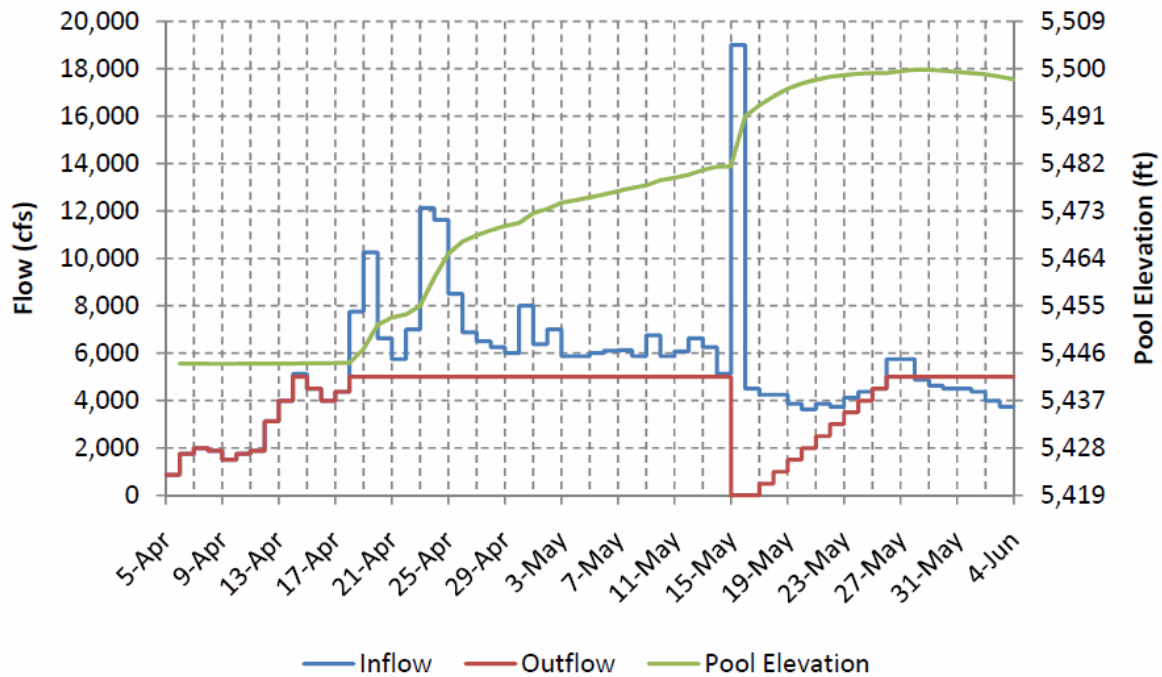


Figure 7-1: RDF pool elevations with a starting elevation of 5444 ft using the 1998 capacity, a 2-day shutdown period, and a 500 cfs per day stepped-release.

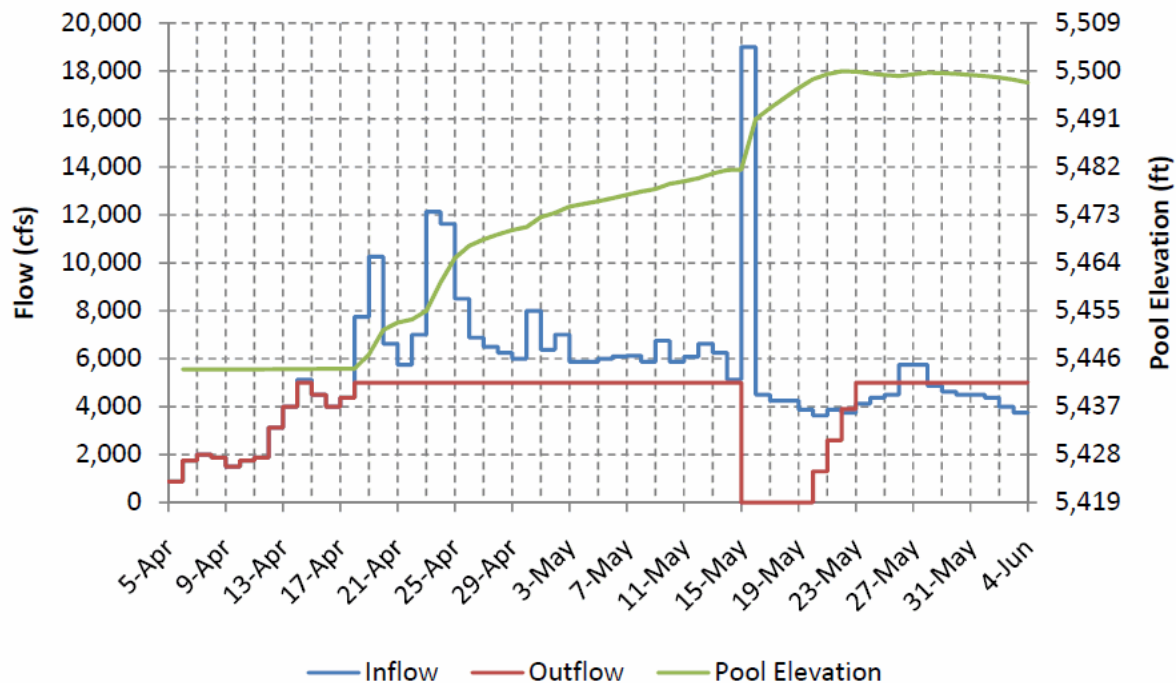


Figure 7-2: RDF pool elevations with a starting elevation of 5444 ft using the 1998 capacity, a 5-day shutdown period, and a 1,300 cfs per day stepped-release.

During flood control operations, the primary consideration in determining reservoir releases will continue to be keeping releases as large as possible up to the 5,000 cfs target at the Denver gage on the South Platte River. However, consideration will also be given to the design assumptions for shutdown period and rate of stepping up releases. This will ensure adequate capacity for the Chatfield Reservoir to control the Reservoir Design Flood without uncontrolled spillway releases and not compromising flood control benefits downstream.

Actual operations from 1974 through 2009, with the base of the flood control pool at 5432 feet above msl, never shutdown releases to zero during a major storm event. The HEC 5 model results from the antecedent flood study reflect that historic storm events routed through the reallocated pool from 1942-2000, with the base of the flood control pool at 5444 feet above msl, never shutdown releases to zero for three days during a major storm event. Releases were shut down to zero in the modeled operations on two occasions for 2 days (1965 and 1969) and on one occasion for 1 day (1973).

c. Surcharge Storage. The surcharge storage zone at Chatfield reservoir includes reservoir pool levels between the spillway crest elevation of 5500.0 feet msl and the maximum pool level of 5521.6 feet msl. For large flood events that cause reservoir pool levels to rise above the spillway crest elevation, it is expected that Chatfield Reservoir will be making a high release of up to 5,000 cfs from the outlet works. As the reservoir levels rise above the spillway crest, the releases from the outlet works may be reduced so that the combined flow from the outlet works and spillway is still within the 5,000 cfs target at the Denver gage on the South Platte River. At reservoir pool elevations above 5502.1, the spillway flow alone would be 5,000 cfs or higher and the outlet works release may be set at zero under those conditions. After the reservoir pool level peaks and pool levels fall to near the spillway crest, outlet works releases may be increased to meet the 5,000 cfs target at Denver stream gage.

With the proposed multipurpose pool at elevation 5444 ft, for the Inflow Design Flood (IDF), an antecedent flood of 40% of the Probable Maximum Flood (PMF) was approved instead of the traditional 50% of the PMF. This criterion was evaluated in the study "Antecedent Flood Study, Tri-Lakes Reallocation Feasibility Study, December, 2005". This resulted in a maximum pool elevation of 5520.9 ft, as compared to the original maximum pool elevation of 5521.6 ft. The original IDF incorporated an antecedent flood of 50% of the PMF and 5432 ft as the top of the multipurpose pool, while the new IDF incorporated an antecedent flood of 40% of the PMF and 5444 ft as the top of the multipurpose pool. A plot of the IDF hydrograph is shown on Plate 8-4.

d. Flood Storage Evacuation. The following paragraphs describe the system regulation plan for flood storage evacuation in the Tri Lakes projects when more than one project has storage in the flood control pool. If Bear Creek and Cherry Creek have empty flood control pools, Chatfield's flood control storage will be evacuated to pool elevation 5444 feet above msl with releases to target 5,000 cfs at the Denver gage. The normal allowable rate increase in releases at Chatfield Dam is 500 cfs/day.

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When water has accumulated in the flood storage zones of the Chatfield, Cherry Creek and Bear Creek, an equal protective balance of flood storage kept vacant should be maintained during the pool evacuation of these projects. This balance is based on establishing an equal risk in each project of filling the remaining flood control space from a similar subsequent flood. The storage remaining should provide equal protection at each project against runoff from rainfall of standard project flood magnitude. Flood Storage Evacuation will continue at Chatfield Dam until the pool elevation falls to 5444 feet above msl, at which time coordination will resume with the State Engineer.

Two storage levels are established in each project. Generally, the upper Level II of storage space approximates the volume of the rainfall standard project flood. In Chatfield, Level II amounts to 160,000 af, the volume of the rainfall standard project flood. As the entire flood control space in both Cherry Creek and Bear Creek Reservoirs was designed mainly for protection from the sudden occurrence of a rainfall standard project flood and not from the longer duration mountain snowmelt flood, 95 percent of this space was assigned to Level II. The remaining space in the three projects was assigned to Level I. The five percent of flood storage space in the Cherry Creek and Bear Creek Projects, which is allotted a lower evacuation rate at the downstream Denver control point, was assigned to Level I to provide for a transition from flood releases to conservation releases and to lessen unnecessary slugging of high releases for small encroachments of the flood pools. The lower evacuation rate of the five percent of storage will not significantly affect the project flood control function. However, as individual design criteria for both the Chatfield and Cherry Creek Projects were based on releasing 5,000 cfs out of each project (and not a combined total release of 5,000 cfs) following the flood peak, strict adherence to these evacuation criteria should be followed. Tables 7-1 and 7-2 present a tabulation of storage in the three projects assigned to each level and desired evacuation flow to be targeted at the Denver stream gaging station control point depending on storage level, percent of storage space filled, and time of year.

Table 7-1 lists the storage and elevations based on the following surveys: Cherry Creek (1988), Chatfield (1998), and Bear Creek (1997).

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Table 7-1
FLOOD REGULATION STORAGE LEVELS

	Level I			Level II		
	Elevation (ft ab msl)	Storage (AF)	Incr. Storage (AF)	Elevation (ft ab msl)	Storage (AF)	Incr. Storage (AF)
Cherry Creek	5550.0	12,800		5555.9	18,300	
	to 5555.9	18,300	5,500*	5608.6	122,500	104,200
Chatfield***	5444.0	48,100		5455.5	74,200	
	to 5455.5	74,200	26,100**	5500.0	234,200	160,000
Bear Creek	5558.0	1,900		5569.2	3,300	
	to 5569.2	3,300	1,400*	5635.5	30,600	27,300

* 5 percent of total flood pool
 ** Total Flood Control Storage (234,200 af minus 48,100= 186,100; minus Standard Project Rainfall Flood (160,000) = 26,100
 *** Flood Control pool in 1973 Chatfield Preliminary Reservoir Regulation Manual indicates the base of the flood control pool at elevation 5430.0 ft above msl. The base of the flood control pool was changed to 5432.0 ft above msl in March 1979 (see Exhibit II, not included, Memorandum of Understanding between COE and State of CO) and possibly to 5444.0 ft above msl in 2010. Additionally, 20,700 af of Level 1 storage is joint-use for both flood control and water supply.

Table 7-2
DESIRED CONTROLLED FLOW TARGET - DENVER STREAM GAGING STATION

April - July:

Any Reservoir at Level II - 5,000 cfs

All Reservoirs at Level I, with one or more, more than 50% filled - 5,000 cfs

All Reservoirs at Level I, and all less than 50% filled - 4,000 cfs

August – March

Any Reservoir at Level II - 5,000 cfs

All Reservoirs at Level I, with one or more, more than 50% filled - 4,000 cfs

All Reservoirs at Level I, and all less than 50% filled - 3,000 cfs

Water will be released from the reservoir with the highest percent of storage, in the highest level, occupied until the storage balance or the percent of storage filled, for the same level, is the same in all reservoirs. Plate 59 (not included) displays the parallel reservoir balance for the three projects in percent of storage space filled for the two levels. When all three reservoirs have the same percentage of storage in the same level, equal balance has been achieved. For example, all reservoirs are in balance at 50% full in Level II at the following storage levels: Chatfield, 154,200 af; Cherry Creek, 70,400 af; Bear Creek, 16,950 af. Table 7-3 gives the parallel reservoir balance for the three projects in percent of storage space filled for the two levels based on the amount

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in the incremental storage column for each level as shown in Table 7-1. When all reservoirs have the same remaining balance of storage, the storage should be kept in balance or the percent of storage filled should be kept the same until all water is evacuated. Table 7-3 shows percent of storage depletion required out of each reservoir to enable continued parallel reservoir balance for all combinations of the three projects that may contain storage. For example, a total of 100 acre-feet (af) of flood control storage occupied among the Tri Lakes projects would reflect an equal balance for Level I - Balance Combination C when Bear Creek had no flood control storage, Chatfield had 83 af (83%) of storage and Cherry Creek had 17 af (17%) of storage.

TABLE 7-3
UPPER SOUTH PLATTE RESERVOIR SYSTEM
PERCENTAGE OF STORAGE DEPLETION REQUIRED OUT OF EACH
RESERVOIR TO ENABLE A CONTINUED PARALLEL
RESERVOIR BALANCE
(Values are in percent)

LEVEL II			
Balance Combination	Chatfield	Bear Creek	Cherry Creek
A	55	9	36
B	85	15	0
C	61	0	39
D	0	21	79
LEVEL I			
Balance Combination	Chatfield	Bear Creek	Cherry Creek
A	79	4	17
B	95	5	0
C	83	0	17
D	0	20	80

Following is an example illustrating how an equal parallel reservoir balance is maintained during storage evacuation using Table 7-3. This example assumes (1) all three reservoirs are in an equal balanced condition as indicated by balance combination A of Level II of Table 7-3, (2) a control point flow of 5,000 cfs at the Denver gage and (3) there are no downstream channel constraints below the three projects. Values tabulated are average daily flows in cfs. After the total release on line 3 is determined, the estimated inflow into the three projects is totaled on line 4. The difference between this total on line 4 (inflow) and line 3 (release needed from 3 projects) represents the

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total storage depletion from the 3 projects on line 5. Table 7-3 is utilized to determine what percent of this storage is required out of each reservoir to enable a continued parallel reservoir balance. The difference between the estimated inflow and storage depletion for each project represents the required release from that project. The total release from the 3 projects represents the required total release needed to target the desired flow at the Denver gage, with an allowance for incremental flow.

1. Desired flow at Denver Gage						5,000
2. Incremental flow* between 3 projects and Denver Gage**						500
3. Total release needed from 3 projects						4500
	Chatfield	Cherry Creek	Bear Creek	Total		
4. Estimated inflow**	1,100	100	0	1,200		
5. Storage depletion***	(55%) 1,800	(36%) 1,200	(9%) 300	3,300		
6. Required release	3,100	1,100	300	4,500		

* Incremental flows are flows that enter the stream downstream of dam releases

** Values to be estimated

*** Values from Table 7-3

e. Regulation Schedule. Regulation rule curves for flood control regulation on Plate 60 (not included) were developed by methods described in Paragraph 4-05 of EM 1110-2-3600, primarily for use during large floods or during emergency regulation. The rule curves will serve as a basis for regulation when other information may not be available. The rule curves are based on a rainfall runoff recession. The curves display the minimum releases for any combination of pool elevation and recession inflow, to assure effective use of the total flood control storage by 1) filling the remaining flood control storage, 2) reducing the maximum flood release, and 3) reducing the magnitude of changes in release rates. As these release rates are minimum values, actual flood control release rates will be kept as large as feasible, to meet the 5,000 cfs target at the Denver gage.

7-06. Recreation. The demand for water-based recreation near the large metropolitan city of Denver is substantial. The Chatfield Project satisfies part of the demand. The sediment pool serves as the recreation pool. In order to fill the sediment pool, local interests agreed to allow storing of water for the pool, recognizing the eventual depletion effects of the sediment pool. In this respect, the Governor of Colorado, by letter of intent, has obligated the State to provide sufficient water to fill the reservoir to the multi-purpose pool elevation of 5432.0 feet above msl and to replace annual evaporation losses. In the event that the storage between 5432 feet above msl and 5444 feet above msl is reallocated, this zone will be operated for multiple purposes, which include recreation, flood control, fish and wildlife and water supply. However, the Omaha District will operate in this zone only for flood control purposes when the reservoir levels are forecasted to rise above 5444 feet above msl.

The Corps of Engineers has maintained a closely coordinated planning effort with the State of Colorado, Department of Natural Resources, and Colorado State Parks. The

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Corps of Engineers constructed recreational areas upstream from the dam that the State of Colorado leases, operates, and maintains for recreation use. Visitation to the Chatfield Project grew from 288,000 in 1976 to approximately 5,240,000 visits per year in FY01 through FY10.

The City of Littleton and South Suburban Recreation and Park District developed the recreation facilities along the South Platte River channel in the portion of the project downstream from the area acquired for Chatfield Dam and Reservoir with Federal financial assistance.

7-07. Water Quality. On-going urbanization will impact Chatfield Reservoir water quality, which in turn could impact future releases.

The Chatfield Basin Water Quality Authority maintains an on-going program that involves water quality monitoring and management of some upstream activities such as sewage treatment.

7-08. Fish and Wildlife. Fish and wildlife is an authorized project purpose at the Chatfield Project.

The basic premise of the flood control aspect of the water control plan is to release stored waters in the flood control zone of the reservoir as soon as possible following inflow from a flood event. This premise may be consistent with management of the fish and wildlife resources of the project as it reduces to a minimum the possible impacts to aquatic and terrestrial wildlife and habitat.

During the 1980's some temporary storage in the flood control zone of Chatfield Reservoir occurred at least once during every year. However, most of the years the water was less than three feet above 5432.0 feet above msl, the conservation pool and flood storage was of very short duration. In only two of the years did flood storage exceed five feet above 5432.0 feet above msl, the conservation pool elevation.

In those two years the storage period was brief; stored water was released as soon as downstream conditions allowed. The shoreline vegetation is relatively tolerant of short periods of inundation so that the shallower, short duration flood events may not cause permanent damage. Longer duration events, however, would present a different picture. Inundation of shoreline and upland vegetation for periods longer than two to three weeks would either seriously injure or kill most of the vegetation as did happen in 1995. In such cases, barren mudflats may occur and a period of succession would ensue that could take several years before the vegetation returned to pre-flooding conditions. The areas also could be seeded or sodded, and weed control will be an issue. It is expected that if a portion of the flood control storage is reallocated to municipal storage, longer periods of inundation will occur relatively frequently.

Because Chatfield Reservoir is a relatively shallow, plains reservoir, it is primarily a

warm-water fishery. Normal operations and normal springtime floodwater inflows would have little effect on the fishery from a water temperature standpoint. Flood inflows could, however, have a temporary negative impact on the lake fishery if high inflows in suspended solids cause the water to become turbid. High turbidity reduces light levels in the lower depths of the lake and interferes with oxygen transfer (breathing) in the aquatic life forms in the lake. As temporary storage increases water residence time, suspended solids will tend to settle out. Settling of particulates may result in the surface waters becoming less turbid, but degradation of organic matter associated with settling particles may deplete oxygen in deeper waters while burial of bottom dwelling organisms may increase sediment oxygen demand.

The outlet works have only a single level for releases. Thus it is not possible to mix water from multiple levels to manage for a particular species of fish.

Chatfield Reservoir is not important from a waterfowl management standpoint. It is not on a major migration flyway and it lacks the vegetation and cover necessary for it to be an important stopover point during spring or fall migration. Some local nesting of a few common waterfowl species likely occurs at the project. Larger numbers of Canada Geese use the reservoir as a roosting area in the fall and winter. Normal flood control operations would not be expected to have any significant impacts on such waterfowl nesting.

The U.S. Fish and Wildlife Service (F&WS) has responsibility for oversight of the Endangered Species Act. The F&WS maintains that temporary storage of floodwaters in upstream reservoirs may have impacts on species that depend on the Platte River downstream for part of their life requisites. The federal agencies that are responsible for manipulations of the Platte River system upstream are said to have some responsibilities for protection of those downstream species. The problem is complex; there are but a few major elements to it. First, detention of upstream floodwaters in upstream reservoirs reduces the peak and the overall volume of the effects the flood would otherwise have on downstream areas. The Platte River in Nebraska, for instance, no longer is impacted by heavy and prolonged spring flooding that once periodically scoured the channel and kept trees from gaining a foothold. Where the channel was once wide, shallow, and relatively treeless, it is now narrower, deeper, and heavily tree-covered in many areas. Each upstream reservoir adds to the situation in a cumulative manner.

The main species of concern on the central Platte River in Nebraska are the whooping crane, least tern, pallid sturgeon and piping plover. All of these species have been designated as federally threatened or endangered. Upstream impoundments and increased depletions from the Platte River have adversely influenced habitat for these downstream species because they have changed the timing and volume of flows. These adverse impacts have accumulated over the past 40 years or more, and continue to influence the flood plain environment. It is also recognized that the future flood control operations of Chatfield Dam will not differ significantly from those of the

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recent past. Therefore, any impacts downstream related to operations of Chatfield Dam will not be different than they are at present. For that reason, it is not anticipated that implementation of the updated water control plan will further impact federally listed species on the Platte River. Similarly, none of the other species of concern are expected to be adversely impacted more so than at present.

The South Platte Watershed within and upstream of Chatfield Park is designated as Critical habitat for Preble's Meadow Jumping Mouse. In the last century, widespread habitat loss and fragmentation due to development, water diversions, overgrazing, water pollution, and gravel and sand mining resulted in a rapid decline of already rare Preble's populations. It is currently listed as a threatened species in Colorado by both the State and Federal government. Increases in the Chatfield flood storage pool may adversely impact mouse habitat if flood control operations result in damage to shoreline, wetland or riparian habitat.

a. Informal Consultation under the Endangered Species Act. Federal agencies bear the responsibility of being in compliance with the provisions of the Endangered Species Act for all their actions that have the potential for adversely affecting threatened and endangered species. In July 1991 the Omaha District began a dialogue with the F&WS and others for informal consultation relative to future operations of the Tri-Lakes project. At that time the Corps anticipated that it would soon begin updates of the water control manuals for the three projects, Bear Creek Lake, Cherry Creek Lake, and Chatfield Lake. The Omaha District proceeded to update the three water control manuals essentially with no change from current operations, and therefore without the requirement for specific consultation. The F&WS concurred in this approach.

7-09. Water Supply. Denver Water, through a 1979 contract with the Colorado Water Conservation Board and Colorado State Parks, is entitled to the use of 11,134 AF of storage in Chatfield Reservoir from elevation 5423 to 5,432 feet above msl. Denver's use of the storage is subject to conditions in the 1979 contract for maintaining water levels for recreation. Under the terms of the 1979 contract, Denver Water commits to use best efforts to keep the reservoir above 20,000 af (current elevation 5,426.32 feet msl) from May 1 to August 31 of each year. Denver Water cannot lower the reservoir below elevation 5,423 feet msl except during severe and prolonged drought conditions as determined by the Colorado Water Conservation Board and agreed to by the Corps of Engineers. Additionally, the 20,600 AF between elevations 5,432 and 5,444 feet above msl of the joint-use zone may be used for water supply in the future yielding a total of 31,734 AF of storage for water supply.

The City Ditch is a carrier ditch that is currently owned and operated by the City of Englewood. It was constructed in 1860 and its original dimensions were approximately 10 feet wide and 20 feet wide at the channel bottom and top of bank, respectively. The original head gate for the diversion of flow from the South Platte River was located near the headwaters of the Chatfield Reservoir conservation pool at about elevation 5425.0

feet above msl. The water rights embodied in the City Ditch diversions are some of the earliest in the area. The current diversion for the City Ditch is through the Chatfield manifold. The ditch has been piped except for some short sections within Englewood. In 2002, the ditch was terminated at the Interstate 25 crossing in Denver, so the northern terminus for the ditch is now a blow-off device near Harvard Gulch in Denver. Being a carrier ditch, it serves customers with raw water in much the same manner as treated water customers are served from a pressure main.

The Plum Creek Pump Station is located on the north side of State Highway No. 75 between City Ditch and the South Platte River. Its purpose is to convey raw water diversions from City Ditch and lift them from elevation 5400.0 feet above msl to 5570.0 feet above msl for further distribution. The development consists of a diversion structure on City Ditch and an earthen stilling reservoir as a source of supply for the suction header serving lift pumps. At the reservoir, a frame structure is located over the inlet control. The pump station was constructed in 1955 and has been well maintained. The intake and pumping plant are below elevation 5426.0 feet above msl.

The Last Chance Ditch is operated as an irrigation and water supply ditch by stockholders owning shares in the Last Chance Ditch Company No. 2. At the inception of the Chatfield Project, the stock list included 31 individual owners of which the City of Aurora owned a controlling interest of about 50.1 percent of the stock. Other municipal owners are Denver Water and the Centennial Water and Sanitation District. The original head gate was located just upstream from the Denver Water's former Kassler Water Treatment Plant and just within the upper limits of the Chatfield Reservoir flood control pool. Current diversion is through the Chatfield manifold to the Last Chance control valve near C-470. The City of Aurora diverts its Last Chance Ditch shares through its intake at Strontia Springs Reservoir.

The Nevada Ditch is a combination irrigation and carrier ditch largely owned by the municipalities of Denver, Englewood and Littleton. Stock records show 260 shares outstanding, of which about 92 percent are owned by the three cities and the rest by individuals. The former diversion point was in the Chatfield Dam embankment area. The head works and ditch facilities were badly damaged in the 1965 flood but have since been rebuilt. Ditch facilities were damaged again by high flows during May of 1969 but have since been restored to service. Current diversion is through the Chatfield manifold to the Nevada control valve near C-470.

The Chatfield State Fish Unit (SFU) was constructed as a component of the required mitigation due to the original construction of Chatfield Reservoir. The SFU is not operated as a full scale hatchery, as was originally intended, due to the lack of a reliable water supply. The SFU does have decreed water rights for the operation of the facility. However, when Denver exercises its more senior Chatfield Reservoir storage and exchange rights, flows through the SFU can be shut off. Therefore the SFU is currently operated as holding facility for fish that have been hatched and reared at other locations. These fish are eventually stocked in streams and lakes primarily within the

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Denver Metro area. When water is available, it is delivered via the 54" pipeline that also serves the City and Nevada Ditches. The Corps of Engineers has allocated 30 cfs of the pipeline capacity to the Division of Wildlife for use at the SFU. If reliable water could be secured, the facility could still be expanded into a full sized hatchery, potentially for both warm and cold water production. This would be an important asset to the Division and the region as population increases and new water projects will increase the demand for fish stocking, particularly in and near the Front Range. At this time it is unknown whether the proposed reallocation of storage space in Chatfield Reservoir will augment or further reduce the available water supply to the SFU.

a. Future Development. The continued growth of the need for water for domestic, irrigation and industrial uses will tend to assure the further development of water supplies for use in the South Platte River basin.

7-10. Hydroelectric Power. None at this project.

7-11. Navigation. None at this project.

7-12. Drought Contingency Plans. A drought contingency plan for Chatfield Dam and Reservoir will be coordinated with stakeholders after approval of the Reallocation.

7-13. Flood Emergency Action Plans. Normal flood regulation of the Chatfield Reservoir is accomplished by specific regulation orders to the Tri-Lakes Project Office from the Omaha District Water Control and Water Quality Section. However, it is conceivable that communication may be disrupted between these offices at times when project events may require changes in existing regulation instructions in order that the project may more properly perform its authorized function. In order that the Tri-Lakes Project Office may have appropriate information and instructions for modifying existing regulation orders, a procedure has been developed to guide the project in determining project operations under such an emergency. This procedure is given under the Emergency Regulation part of the Standing Instructions to the Dam Tender, Exhibit I (not included). This procedure is defined to begin with a failure in communications between the Tri-Lakes Project Office and the Omaha District Water Control and Water Quality Section personnel at a time when the reservoir is rising rapidly, high inflows are indicated, excessive rainfall has occurred, flooding below the dam is occurring or appears imminent, or when a combination of any of these is occurring. During such emergency periods, regulation of project releases will be made by the Tri-Lakes Project Office in accordance with the instructions given in Exhibit I (not included). Continuing efforts will be made to re-establish communications. Also, Annex A to EM 500-1-1, Standing Operating Procedures for Flood Emergency Operations, describes emergency procedures.

7-14. Deviation from Normal Regulation. Temporary deviations from the normal flood control regulation plan may be made if conditions warrant. Deviations require

prior approval from the Northwestern Division Commander except as noted under the following paragraph, 'a. Emergencies'. Requests to deviate from normal regulation of the project fall into one of the categories described below.

a. Emergencies. Deviations from the release schedule will be made if emergency conditions exist upstream or downstream of the dam. Examples of these types of emergencies include dam safety emergencies, downstream chemical spills, drownings and facility failures. During an emergency activity, the Omaha District will inform the Northwestern Division of its activities as soon as possible. Written confirmation of the deviation, including a description of the cause of the emergency, will be furnished as soon as practicable to the Northwestern Division water control manager as shown in NWDR 1110-2-6.

b. Unplanned Minor Deviations. Temporary delays of a few days duration in evacuation of flood storage will be considered to mitigate damages and/or for special circumstances downstream. A typical example of activities that would create the potential for unplanned minor deviations would be modifications of bridge and utility crossings. In evaluating requests for these types of deviations, the Omaha District will consider upstream watershed conditions, potential flood threats, the amount of water in storage at Chatfield Reservoir, and whether any alternative measures could be taken that would not require a deviation. Written request of the deviation will be furnished to the Northwestern Division water control manager as shown in NWDR 1110-2-6.

c. Planned Deviations. Deviations from the release schedule will be made if conditions at the time are such that improved reservoir regulation will result. All conditions such as data on flood potential, lake and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes will be analyzed. Planned deviations will be coordinated with all appropriate entities, including locals and state offices and a written request will be furnished to the Northwestern Division water control manager as shown in NWD 1110-2-6.

7-15. Rate of Release Change. Normally, increases in releases should not exceed 500 cfs per day. Releases may be reduced at any rate, even to zero if required, in a single gate change. Reservoir drawdown should not be more than 2 feet per day if embankment stability is in question.